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ABSTRACT

Tests are described that were given to 1,000 students randomly selected at grade 7-9 levels with an equal representation from both sexes. Participants were selected from two junior high schools in North York for a study comparing students in a regular physical education program to those in a program to develop cardiovascular endurance. The first half of the paper describes six Canadian Association for Health, Physical Education, and Recreation (CAHPER) tests in terms of purpose, equipment, performance, scoring, and gives normative data for each test for boys and girls ages 12, 13, and 14. CAHPER Fitness Tests include the one-minute speed sit up, the standing broad jump, the shuttel run, the flexed arm hand, the 50-yard run, and the 300-yard run. In the second part of the paper a discussion is given about cardiovascular fitness and its importance and role in today's society. Several methods of estimating cardiovascular endurance are explained and norm tables for the three age levels follow. In addition, norms are provided for peak respiratory flow, grip strength, and percent body fat. (DMT)

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RESEARCH REPORT

ED127326

NORTH YORK FALL NORMS FOR BOYS AND GIRLS

AGE 12 - 14 FOR:

CAHPER TESTS
MEASURES OF AEROBIC FITNESS
PEAK FLOW
MUSCLE STRENGTH
PERCENT BODY FAT

Patricia Thompson
July, 1975

U.S. DEPARTMENT OF HEALTH
EDUCATION & WELFARE
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INTRODUCTION

During the past decade, Canadians have shown increasing interest in and concern with the physical fitness of the population as a whole and Canadian youth in particular.

One outcome of this concern was the development of national norms on a set of six tests of physical fitness * as well as for physical work capacity**.

In 1974, the Research Department of the North York Board of Education received a grant from the Ministry of Education to compare the changes which occur in measures of physiological response to exercise, muscular strength, agility and endurance in two groups of Junior High School students. One group of students participated in a regular physical education program and the second group in a program designed to develop cardiorespiratory endurance. A second purpose of this study was to compare the performance of North York students to the Canadian norms, for the fitness tests and physical work capacity.

Working in co-operation with Dr. R.C. Goode, Department of Physiology, University of Toronto, data were collected on a variety of measures in the Fall of 1974, prior to implementing the aerobic program and again in February/March, 1975 at the conclusion of the program***.

An analysis of the pre-test data indicated that on several of the CAHPER tests as well as the measure of physical work capacity, North York students were performing at a level considerably above that of the Canadian norm sample. It was decided, therefore, to establish local norms for North York, based on the pre-test data.

The first half of this booklet describes the six CAHPER tests in terms of purpose, equipment, performance, scoring, and gives normative data for each test for boys and girls, ages 12, 13 and 14. The second half of the booklet describes cardiovascular fitness, its

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* "The CAHPER Fitness Performance Test Manual for Boys and Girls 7 to 17 years of age". Canadian Association for Health, Physical Education and Recreation, 1966.

** "The Physical Work Capacity of Canadian Children aged 7 to 17". Canadian Association for Health, Physical Education and Recreation, 1968.

*** A comparison of the fall and spring results for the two schools is documented in the following report: Thompson, Patricia, Crawford, Patricia, Virgin, A.E. and Goode, R.C. "A Comparison of the Effects of Two Physical Education Programs on the Physiological Development of Adolescent Boys and Girls". Educational Research Services, Board of Education for the Borough of North York. July, 1975.

importance and role in today's society. Several methods of estimating cardiovascular endurance are explained and norm tables for the three age levels follow. In addition, norms are provided for Peak Expiratory Flow, Grip Strength and Percent Body Fat.

Sample and Data Collection

The sample included approximately 500 students in each of two North York Junior High Schools which were similar in terms of the amount of time allotted to physical education and the socio-economic status of the communities they served. The 1000 participating students were randomly selected at the Grade 7 through 9 levels providing for an equal representation from both sexes. The nurses' lists were checked to identify and exempt those students who had any type of physical disability (3%) which might interfere with their ability to complete the tests.

The mean weight for each of the three age groups to be included in the norms are shown in the following table. Age was calculated as of September 30.

AGE DISTRIBUTION AND BODY WEIGHT (kg)

BOYS				GIRLS		
Mean	S.D.	N	AGE (In Years)	N	Mean	S.D.
42.9	9.1	148	12	156	43.8	7.5
48.0	9.8	157	13	193	48.2	7.7
52.3	9.9	137	14	135	52.1	7.2

1 kg = 2.203 pounds

From early September to the end of October data were obtained from students in both schools. The physical education staff at each school tested the students on all the CAHPER tests, 12 minute field test and the 600 yard run. The remainder of the tests were conducted by testers hired for the study.

CAHPER FITNESS TESTS

THE ONE MINUTE SPEED SIT UP

Purpose	-	To test the muscular strength and endurance of the abdominal muscles
Equipment	-	Gym mat and stop watch
Start	-	The subject assumes a back lying position on the mat and interlocks his fingers behind his head. The knees are bent and the feet are held flat on the floor by a partner.
Performance	-	The subject sits up and touches both elbows to his knees. Then he returns to the starting position.
Scoring	-	The movement sit up and return is counted as one execution. The total score is the number of complete executions performed in 60 seconds. Count when the elbows touch the knees. Allow one trial.
Controls	-	Partner prevents the subject from sliding and to maintain the starting position of the legs throughout the test only the shoulders have to touch the floor. The sit ups do not need to be performed continuously.

THE STANDING BROAD JUMP

Purpose	-	To measure the explosive strength or power of the legs.
Equipment	-	A 10 foot tumbling mat and cloth tape measure.
Start	-	The subject assumes a standing position with the feet slightly apart and the toes behind the take off line.
Performance	-	The hips, knees, and ankles should be bent enough so that the subject can vigorously push with his legs and swing his arms to jump as far forward as possible.
Scoring	-	Measurement is in terms of inches to the nearest inch from the take off line to the heel of the foot nearest the take-off line. Two or three practice trials are allowed.
Controls	-	Two valid trials are allowed, the better trial recorded. If any part of the body touches behind the heels, the jump will be considered invalid.

THE SHUTTLE RUN

Purpose	-	To determine one's speed and agility
Equipment	-	Two wooden blocks (2" x 3" x 3") and a stop watch
Start	-	The subject lies face down, hands at the sides of the chest and the forehead on the starting line.
Performance	-	On the signal, the subject jumps to his feet and runs 30 feet to the line. He picks up one block of wood, returns to the starting line, and places the block behind this line. He returns to the initial line, picks up the second block of wood and runs back across the finish line.
Scoring	-	Measurement is in terms of seconds from the starting signal until the subject's chest crosses the finish line.
Controls	-	The test should be taken in gym shoes or barefoot. Two trials with sufficient rest between are allowed and the better trial is recorded.

THE FLEXED ARM HANG

Purpose	-	To indicate the muscular endurance of the arm and shoulder muscles.
Equipment	-	A doorway gym bar or horizontal bar placed 6 feet from the floor, a bench and a stop watch.
Start	-	The subject takes a reverse grip on the bar (palms toward the face). He is assisted to the position on the bar so that his eyes are at the level of the bar. Arms are fully bent.
Performance	-	The subject holds himself at this position as long as he is able.
Scoring	-	The total length of time that the subject can maintain the exact position is determined to the nearest second.
Controls	-	The subject must keep the eyes at level of the bar. When the subject's head drops below the bar, the test is terminated. One trial is allowed.

THE 50 YARD RUN

Purpose	-	To measure the individual's speed.
Equipment	-	A 50 yard straightaway with markers at the start and the finish line, stop watch.
Start	-	A racing crouch start or standing position.
Performance	-	On the starting signal, the runner sprints the 50 yard distance as fast as he can.
Scoring	-	The elapsed time from the starting signal to the passage of the runner's chest across the finish line is scored.
Controls	-	The test is taken in gym shoes.

THE 300 YARD RUN

Purpose	-	To measure one's stamina or endurance
Equipment	-	Same as for 50 yard run
Start	-	Racing crouch or standing position
Performance	-	On the starting signal the subject runs straight up and around the stake marker and back over the 50 yard straightaway. The circuit is run 3 times.
Scoring	-	The elapsed time from the starting signal to the passage of the runner's chest across the finish line is scored.
Controls	-	The test is taken in gym shoes.

PERCENTILE NORMS TABLES

For

BOYS AND GIRLS, AGES 12 - 14

ONE MINUTE SPEED SIT UPS

Score (Number)	BOYS			GIRLS		
	12 Year Percentile	13 Year Percentile	14 Year Percentile	12 Year Percentile	13 Year Percentile	14 Year Percentile
14					1	1
16	1	1			2	2
18	2	2		1	4	3
20	2	2	1	3	5	3
22	2	2	2	5	8	4
24	3	3	3	7	11	7
26	5	3	3	11	16	10
28	9	6	4	14	18	13
30	12	9	7	19	23	18
32	19	16	10	26	30	27
34	22	20	13	31	39	33
36	27	30	18	41	48	43
38	36	35	23	53	58	50
40	43	41	30	61	65	59
42	51	54	42	71	76	69
44	62	61	53	80	77	78
46	71	70	64	84	87	86
48	77	75	73	90	92	91
50	86	82	83	94	94	94
52	91	89	87	97	96	98
54	93	92	92	98	97	
56	95	96	97	99	98	
58	98	97	99		99	
60	99	98				
Average	40.1	41.3	43.0	37.2	35.5	36.9
Standard Deviation	10.2	9.0	7.9	8.3	9.5	8.9
Number of Students	140	157	132	165	187	127

STANDING BROAD JUMP

Score (Inches)	BOYS			GIRLS		
	12 Year Percentile	13 Year Percentile	14 Year Percentile	12 Year Percentile	13 Year Percentile	14 Year Percentile
42	0				0	0
44	1				1	1
46	1	0		0	1	3
48	1	1		1	2	4
50	1	2		1	3	4
52	2	2	0	3	4	5
54	4	5	1	7	8	6
56	9	8	1	10	11	9
58	11	10	3	18	15	13
60	18	13	5	26	19	17
62	28	18	9	32	25	21
64	37	23	11	41	34	28
66	49	32	14	53	46	36
68	59	39	21	63	54	45
70	70	49	30	73	64	53
72	81	60	37	83	73	65
74	88	71	46	90	80	72
76	92	82	52	96	87	82
78	95	87	60	99	93	89
80	98	89	66	99	96	95
82	100	92	73	99	98	97
84		93	82	99	99	99
86		97	89	100		
88		98	93			
90		99	96			
92		100	99			
Average	66	70	75	65	67	68
Standard Deviation	7	9	9	7	8	9
Numbe.	148	156	135	157	194	136

SHUTTLE RUN

Score (Time in Seconds)	BOYS			GIRLS		
	12 Year Percentile	13 Year Percentile	14 Year Percentile	12 Year Percentile	13 Year Percentile	14 Year Percentile
14.2					3	
14.0				2	4	
13.8	2			3	5	
13.6	3	1	0	4	5	1
13.4	4	2	1	6	7	4
13.2	4	2	1	7	7	4
13.0	5	2	1	11	9	5
12.8	7	2	1	13	10	7
12.6	9	3	1	16	13	9
12.4	12	7	3	20	18	13
12.2	15	10	6	23	21	15
12.0	25	15	11	35	29	22
11.8	32	20	14	43	34	28
11.6	38	25	17	53	40	34
11.4	49	33	21	65	53	45
11.2	55	39	24	72	63	55
11.0	68	50	34	83	80	71
10.8	76	59	40	87	87	80
10.6	81	65	55	92	94	88
10.4	92	80	67	98	97	96
10.2	93	87	73	99	98	98
10.0	98	95	88	100	99	100
9.8	99	97	95		99	
9.6	100	100	99		99	
Average	11.5	11.2	10.8	11.9	11.8	11.5
Standard Deviation	1.0	0.8	1.1	0.9	1.3	0.8
Number	136	151	135	155	191	134

FLEXED ARM HANG

Score (Seconds)	BOYS			GIRLS		
	12 Year Percentile	13 Year Percentile	14 Year Percentile	12 Year Percentile	13 Year Percentile	14 Year Percentile
1	1	1	0	1	3	0.4
6	4	2	1	11	14	13
11	9	8	5	23	26	23
16	14	14	7	38	39	36
21	21	21	13	50	49	46
26	30	27	18	61	61	54
31	41	32	23	69	71	64
36	48	40	27	77	77	73
41	58	50	35	84	87	81
46	64	58	41	89	91	86
51	69	67	48	93	94	88
56	74	73	58	94	94	91
61	80	75	68	98	96	96
66	86	83	76	99	98	99
71	88	87	84		99	
76	94	92	87			
81	96	95	90			
86	99	97	92			
91		98	96			
96		98	98			
101		99	99			
Average	40	43	50	25	24	26
Standard Deviation	22	23	23	17	17	17
Number	145	153	135	157	194	136

50 YARD RUN

Score (Time in Seconds)	BOYS			GIRLS		
	12 Year Percentile	13 Year Percentile	14 Year Percentile	12 Year Percentile	13 Year Percentile	14 Year Percentile
9.8					1	
9.6					2	0
9.4					4	1
9.2	2			0	7	1
9.0	6	2		4	7	1
8.8	8	4		6	9	3
8.6	11	6	1	13	13	9
8.4	19	14	2	24	19	15
8.2	29	18	4	29	23	20
8.0	49	30	10	47	38	32
7.8	60	41	17	58	47	43
7.6	72	56	24	68	59	51
7.4	85	73	39	81	74	73
7.2	88	84	50	88	81	82
7.0	95	95	70	95	91	94
6.8	97	98	81	97	97	98
6.6	99	100	89	99	99	99
6.4	100		96	100	100	100
6.2			98			
6.0			100			
Average	66	70	75	65	67	68
Standard Deviation	7	9	9	7	8	9
Number	148	156	135	157	194	136

300 YARD RUN

Score (Time in Seconds)	BOYS			GIRLS		
	12 Year Percentile	13 Year Percentile	14 Year Percentile	12 Year Percentile	13 Year Percentile	14 Year Percentile
90						
88						
86						
84				0		
82				1		
80	1			2		1
78	3			5	3	3
76	3	0		6	5	5
74	5	2		9	8	6
72	9	4	0	15	12	10
70	12	4	2	25	21	17
68	25	9	5	41	31	28
66	38	17	12	56	40	42
64	49	33	14	73	57	58
62	60	49	22	83	70	72
60	74	65	33	90	84	82
58	87	80	44	96	95	92
56	95	90	63	98	98	96
54	99	96	79	99	99	99
52	100	99	89	100	100	100
50		100	95			
48			100			
Average	64	62	58	67	66	66
Standard Deviation	6	5	5	5	6	7
Number	140	146	131	157	187	132

CARDIO VASCULAR FITNESS

Cardiorespiratory fitness (or endurance fitness) is a most important factor in human performance. It refers to the ability of being able to persist in prolonged general physical activity, to resist fatigue and to do large amounts of physical work.

Cardiorespiratory fitness depends upon the condition of the

1) lungs, heart and vascular system

2) general musculature

3) body energy storage

There is a definite need to educate all Canadians as to the important benefits of physical fitness and how to become fit.

Exercise must be done on a regular basis and involve large muscle masses (i.e. swimming, jogging, bicycling, etc.) There must be some stress put on the body before it can experience any training effect or improvement in health.

Proper training will not only improve your health but will make you generally "feel better" and enable you to cope and get through the day easier. Many changes occur as one becomes fit.

1) Resting heart rate will decrease
2) The coronary output will increase (the efficiency of the heart to pump blood to the muscles and cells of the body is increased)
3) The amount of oxygen feeding the muscles will increase
4) The muscles will have greater capillarization (an ability to take in more oxygen)
5) Total blood volume will increase
6) Heart volume will increase

The following pages outline different tests that can be given to individuals to measure their cardiorespiratory fitness.

THE 12 MINUTE FIELD TEST

Purpose - To determine the individual's stamina and endurance and to measure oxygen uptake or the ability of each child to supply oxygen to the cells of the body.

Equipment	-	A large tenth of mile field or quarter mile track and stop watch.
Start	-	The subject assumes a racing crouch or standing position
Performance	-	On the starting signal, the subject begins to run around the designated area as many times as he can in the 12 minute time limit.
Scoring	-	The number of miles run in the 12 minute time limit to the nearest tenth of a mile.
Controls	-	The test is run in gym shoes. One student should count the number of laps his partner runs, mark it down on a score sheet.

THE 600 YARD RUN

Purpose	-	Further indication of stamina or cardiovascular endurance
Equipment	-	A pre-measured running path and stop watch
Start	-	The subject assumes a racing crouch or standing position.
Performance	-	On the starting signal the subject runs the designated distance as fast as he can.
Scoring	-	The time elapsed from the starting signal until the runner passes his chest over the finish line is scored.
Controls	-	The test is run in gym shoes.

THE PHYSICAL WORK CAPACITY 170 (PWC_{170}/kg)

Purpose - To determine one's cardiorespiratory endurance or the efficiency of the individual's body to take up, transport and give off oxygen to the muscle tissue.

Equipment - A bicycle ergometer, electrocardiogram, stop watch and metronome.

Start - The student sits on the bicycle and is connected to an electrocardiogram by three electrodes which monitor his heart rate at different times throughout the test.

Performance - The subject continuously pedals the ergometer at three sub-maximal work-loads for a total time of sixteen minutes. A metronome emits a steady beat (108) that the individual must pedal to for the entire test. Each student works against the first work-load for four minutes, and against the second and third work-loads for six minutes each.

Scoring - Heart rates were recorded at the fourth, eighth, ninth, fourteenth and fifteenth minutes. The PWC_{170} measurement is the result of a series of calculations made from the bicycle test. PWC_{170} measures the amount of work or resistance an individual must pedal against to bring his heart rate up to 170 beats per minute. By plotting heart rate versus work-load and then extrapolating the line to a heart rate of 170, the Physical Work Capacity (PWC_{170}) can be determined (see Appendix A). This value must then be divided by the

individual's weight as PWC varies with body size. The higher the work-load that any individual can withstand at a heart rate of 170, the more fit he is.

THE ASTRAND/kg CALCULATION

Purpose	-	To determine one's cardiorespiratory endurance or the efficiency of the individual's body to take up, transport and give off oxygen to the muscle tissue.
Equipment	-	A bicycle ergometer, electrocardiogram,stop watch and metronome.
Start	-	The student sits on the bicycle and is connected to an electro-cardiogram by three electrodes which monitor his heart rate at different times throughout the test.
Performance	-	The subject continuously pedals the ergometer at three sub-maximal work-loads for a total time of sixteen minutes. A metronome emits a steady beat (108) that the individual must pedal to for the entire test. Each student works against the first work-load for four minutes, and against the second and third work-loads for six minutes each.
Scoring	-	This calculation is another means to indirectly predict an individual's maximal oxygen uptake or his ability to take up, to transport and give off oxygen to the cells of the body. To calculate this measurement one uses an Astrand nomogram (see Appendix B). Again the higher the value the more fit you are.

PERCENTILE NORMS TABLES

FOR BOYS AND GIRLS, AGES 12 - 14

12 MINUTE FIELD TEST

Score (Mile & tenths)	BOYS			GIRLS		
	12 Year Percentile	13 Year Percentile	14 Year Percentile	12 Year Percentile	13 Year Percentile	14 Year Percentile
0.4	0	0.4			0	0.4
0.5	0	1			1	1
0.6	0	1			1	1
0.7	0.4	1		0	2	1
0.8	1	1		1	3	1
0.9	1	1	0	1	4	1
1.0	3	2	2	10	14	9
1.1	11	7	6	32	36	26
1.2	20	14	10	57	56	44
1.3	32	27	17	75	73	65
1.4	51	47	27	87	86	83
1.5	71	64	46	95	95	92
1.6	90	82	73	100	99	99
1.7	98	94	90		100	
1.8	100	98	96			
1.9	100		99			
Average	1.5	1.5	1.6	1.3	1.3	1.3
Standard Deviation	0.2	0.2	0.2	0.2	0.2	0.2
Number	145	154	132	154	190	131

600 YARD RUN

Score (Time in Seconds)	BOYS 12 Year Percentile	BOYS 13 Year Percentile	BOYS 14 Year Percentile	GIRLS 12 Year Percentile	GIRLS 13 Year Percentile	GIRLS 14 Year Percentile
172	2	0		6	8	
170	3	1		9	9	
168	3	2		12	10	
166	5	2		15	11	8
164	6	3		17	14	9
162	7	5		19	17	13
160	10	5		24	19	16
158	12	6	1	27	21	17
156	15	9	3	30	23	19
154	18	11	4	34	28	24
152	23	12	4	41	32	27
150	27	15	5	46	41	29
148	30	17	6	55	47	31
146	33	19	7	63	53	40
144	38	23	9	67	57	52
142	43	29	11	74	64	59
140	50	38	13	77	71	66
138	56	43	17	82	78	72
136	62	50	21	85	84	76
134	67	56	27	87	89	80
132	71	60	34	89	92	85
130	75	66	40	93	94	89
128	82	71	43	95	97	93
126	89	76	49	98	98	95
124	93	82	56	99	99	98
122	97	87	67	100	100	99
120	98	94	74			100
118	99	95	81			
116	100	97	85			
114		98	91			
112		99	93			
110		100	94			
108			97			
106			99			
104			100			
Average	142	136	128	151	149	147
St. Deviation	15	13	12	15	15	18
Number	141	151	128	153	183	127

PHYSICAL WORK CAPACITY 170/kg

SCORE (Work load/ kg	BOYS			GIRLS		
	12 Year Percentile	13 Year Percentile	14 Year Percentile	12 Year Percentile	13 Year Percentile	14 Year Percentile
5.2						1
5.7					1	2
6.2	1			1	4	3
6.7	2			4	10	6
7.2	3	0	1	7	15	9
7.7	5	2	2	10	19	16
8.2	6	3	4	14	26	25
8.7	8	7	5	24	35	29
9.2	12	10	6	30	41	38
9.7	16	13	10	39	50	50
10.2	24	17	14	47	56	59
10.7	29	24	18	55	64	66
11.2	35	28	24	61	71	72
11.7	41	35	34	66	81	78
12.2	49	41	42	75	85	85
12.7	55	52	47	83	88	88
13.2	62	63	57	85	93	91
13.7	67	69	62	89	94	94
14.2	70	76	70	89	95	95
14.7	74	81	77	93	98	96
15.2	77	83	84	94	99	98
15.7	81	85	87	96		99
16.2	86	88	89	96		
16.7	90	90	92	97		
17.2	92	93	93	99		
17.7	93	94	93			
18.2	95	95	95			
18.7	97	96	95			
19.2	97	97	97			
19.7	98	98	98			
20.2	99	99	99			
20.7						
Average	13	13	13	11	10	10
Standard Deviation	3	3	3	3	2	2
Number	142	148	135	151	185	132

ASTRAND/kg

Score	BOYS			GIRLS		
	12 Year Percentile	13 Year Percentile	14 Year Percentile	12 Year Percentile	13 Year Percentile	14 Year Percentile
20.0					1	
21.0					2	
22.0	1				2	1
23.0	2			1	2	3
24.0	3			2	4	5
25.0	3	0	1	3	7	5
26.0	3	1	2	5	8	7
27.0	5	3	3	6	9	10
28.0	6	6	5	7	11	13
29.0	7	7	7	8	16	15
30.0	8	9	7	11	23	18
31.0	11	12	8	15	26	20
32.0	13	13	12	19	31	29
33.0	16	15	14	22	36	31
34.0	18	17	17	26	40	40
35.0	23	20	19	33	44	42
36.0	29	23	23	36	47	49
37.0	33	28	28	44	51	55
38.0	37	32	31	48	57	58
39.0	39	36	38	53	63	61
40.0	42	44	46	58	67	67
41.0	49	49	54	60	74	71
42.0	52	55	59	63	79	74
43.0	55	59	64	67	80	78
44.0	57	66	72	69	82	82
45.0	61	70	75	71	86	85
46.0	64	74	77	74	87	90
47.0	68	75	79	78	89	92
48.0	70	80	84	81	91	92
49.0	73	83	86	83	92	93
50.0	77	86	87	86	94	95
51.0	81	88	89	88	94	96
52.0	84	88	90	90	96	97
53.0	86	89	90	92	98	
54.0	88	91	92	93	98	
55.0	90	92	92	95	98	
56.0	93	96	94	96	99	
57.0	95	97	95	97		
58.0	96	97	96	97		
59.0	96	97	97	97		
60.0	96	99	98	98		
61.0	97		99			99
Average	42	42	41	40	37	37
Std. Deviation	10	8	8	9	8	8
Number	146	154	132	154	186	134

PEAK EXPIRATORY FLOW

Purpose	-	To measure the maximum flow rate of air (liters/min.) in a single forced expiration. The test indicates the individual's lung ventilatory function and reflects the strength or weakness of the respiratory muscle and/or air way obstruction.
Equipment	-	A Wright Peak Flow Meter
Start	-	The subject holds the flow meter in his hands, puts the mouthpiece in his mouth.
Performance	-	The subject takes a deep breath and blows into the instrument as hard and as fast as he can
Scoring	-	The highest value from the three attempts was recorded.

PEAK EXPIRATORY FLOW

Score (Litres/min.)	BOYS			GIRLS		
	12 Year Percentile	13 Year Percentile	14 Year Percentile	12 Year Percentile	13 Year Percentile	14 Year Percentile
210	1					
220	2					
230	2			1	1	
240	3	1		2	2	
250	5	2		3	2	
260	8	3		5	2	
270	10	4	0	9	5	
280	15	4	1	10	7	
290	18	8	3	12	7	1
300	24	9	4	15	9	2
310	28	12	5	21	10	3
320	35	16	8	30	14	4
330	44	22	9	36	18	5
340	53	27	10	46	23	8
350	61	30	13	51	30	15
360	68	36	16	58	36	23
370	72	41	19	65	41	28
380	79	49	23	73	49	37
390	86	55	31	81	55	45
400	91	65	41	86	64	55
410	93	70	45	90	71	61
420	94	77	49	93	77	72
430	97	82	55	96	83	79
440	98	87	61	99	89	83
450		90	65		93	86
460		92	70		97	92
470		93	73		99	95
480		95	77			97
490		96	81			98
500		97	85			
510			88			
520			92			
530			94			
540			96			
Average	337	380	425	347	377	397
Standard Deviation	52	63	69	50	54	48
Number	148	156	135	156	194	136

PERCENT BODY FAT

Purpose	-	To measure the percent of fat on the individual
Equipment	-	Calibrated Skin calipers
Start	-	The tester measures the body fat by skin fold calipers at several different areas of the body
Performance	-	For the boys the areas were the tricep area on the back of the arm, the subscapular region on the back, the chest, the superiliac region (hip), the abdomen, and the front thigh. For the girls, the areas were the tricep area on the back of the arm, the subscapular region on the back, the superiliac region (hip), the abdomen, and the front and back thigh.
Scoring	-	The formula for calculating Percent Body Fat is as follows: (Sum of 6 measures X . 1) + 3.6 = Percent Body Fat .

PERCENT BODY FAT

Score (Percent)	BOYS			GIRLS		
	12 Year Percentile	13 Year Percentile	14 Year Percentile	12 Year Percentile	13 Year Percentile	14 Year Percentile
15.7				8	7	9
15.4				10	8	10
15.1				11	9	11
14.8				12	9	14
14.5				12	10	15
14.2		7		13	10	17
13.9		8		15	12	18
13.6	8	9	3	17	15	21
13.3	11	11	4	17	17	24
13.0	12	11	5	18	21	26
12.7	12	11	5	20	24	28
12.4	14	11	7	23	27	34
12.1	16	12	8	25	31	43
11.8	18	13	9	28	35	50
11.5	19	17	10	31	42	55
11.2	20	17	10	35	49	59
10.9	22	18	11	41	54	68
10.6	25	19	12	45	61	73
10.3	28	20	13	50	65	76
10.0	30	24	15	55	74	83
9.7	34	27	17	61	79	87
9.4	37	29	18	67	83	92
9.1	42	33	19	75	87	94
8.8	46	41	22	79	90	96
8.5	51	46	31	85	94	97
8.2	57	51	35	90	97	99
7.9	67	60	44	95	98	100
7.6	73	67	59	98	100	
7.3	82	82	71	99		
7.0	90	91	87	100		
6.7	97	96	96			
6.4	98	98	99			
6.1	100	100	100			
Average	9.6	9.3	8.5	11	12	12
Standard Dev.	3	3	2	3	3	2
Number	148	157	137	157	193	136

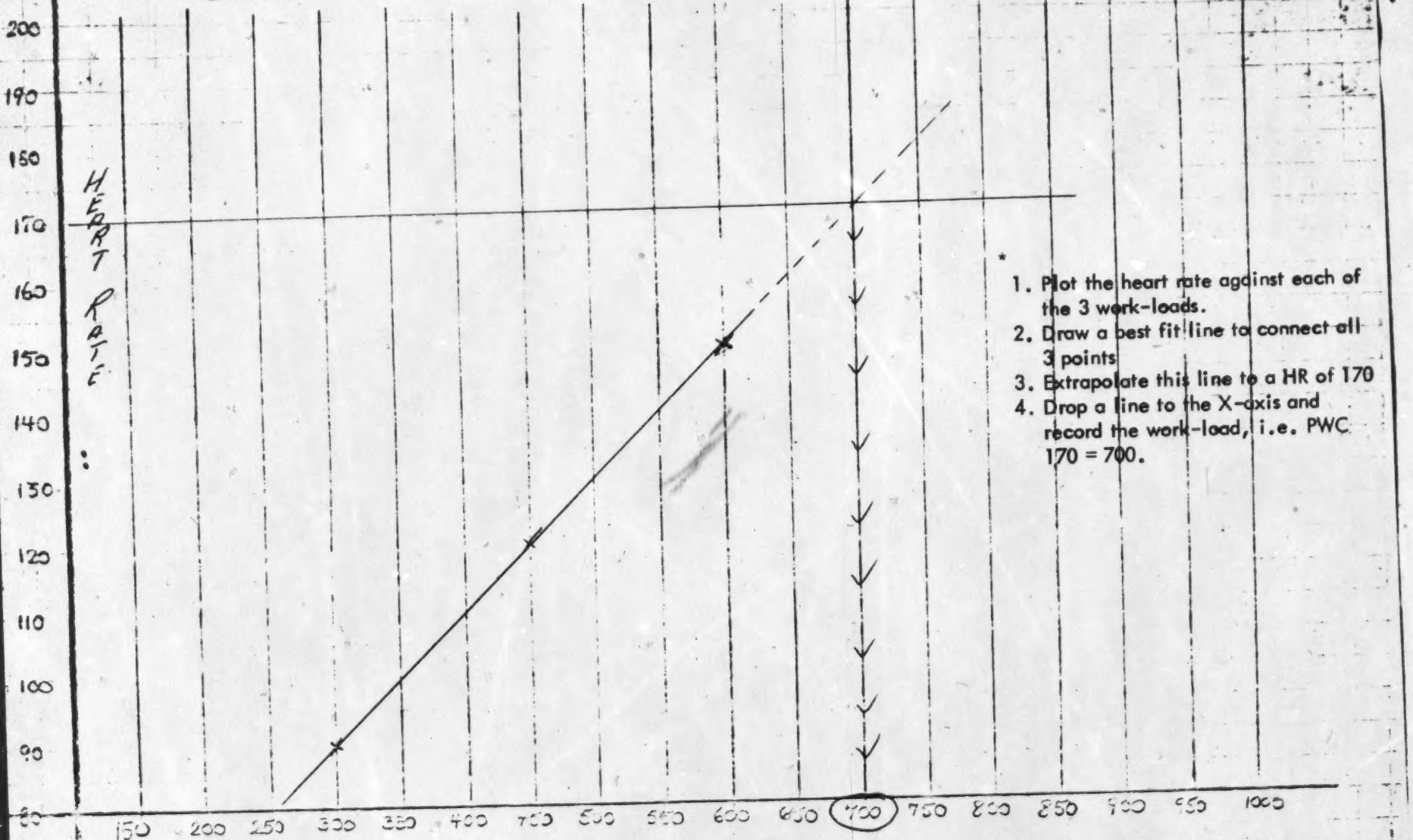
MUSCLE STRENGTH

Purpose	-	To determine the individual's body strength
Equipment	-	A hand grip dynamometer
Start	-	The subject holds the dynamometer in his hand, keeps his arm straight by his side without touching his body.
Performance	-	The subject must squeeze the apparatus as hard as he can.
Scoring	-	Measurements were taken for both hands, the higher of the two readings was recorded and the dominant hand score used to represent the muscle strength of each subject.

MUSCLE STRENGTH

Score (Pounds)	BOYS			GIRLS		
	12 Year Percentile	13 Year Percentile	14 Year Percentile	12 Year Percentile	13 Year Percentile	14 Year Percentile
24				0		
26				1	0	
28				2	1	
30				3	1	0
32	0			4	3	1
34	1	0		6	3	1
36	1	1		10	5	2
38	5	2	0	17	8	3
40	7	3	0.8	24	12	5
42	11	3	1	33	17	5
44	15	5	2	37	24	7
46	19	12	4	47	29	11
48	31	17	4	57	37	18
50	36	20	5	62	41	22
52	41	23	6	70	48	25
54	49	29	6	74	52	30
56	62	33	8	77	56	39
58	72	38	13	83	65	48
60	80	42	17	88	73	60
62	85	47	23	90	78	66
64	88	54	26	91	82	72
66	89	60	32	94	86	74
68	91	69	40	97	89	81
70	92	73	42	97	92	86
72	93	74	45	98	92	87
74	94	75	49		94	89
76	95	78	54		95	90
78	96	80	57		97	96
80	97	83	60			96
82	99	85	61			99
84		86	63			100
86		87	65			
88		90	72			
90		92	75			
92		94	78			
94		95	82			
96		97	83			
98		98	84			
100		98	84			
102		99	87			
104			90			
106			90			
108			93			
110			95			
112			96			
Average	54	64	77	48	54	58
Std. Dev.	11	16	19	11	12	11
Number	147	156	134	157	193	135

PHYSICAL WORK CAPACITY 170



1. Plot the heart rate against each of the 3 work-loads.
2. Draw a best fit line to connect all 3 points
3. Extrapolate this line to a HR of 170
4. Drop a line to the X-axis and record the work-load, i.e. PWC 170 = 700.

PWC 170 700

ASTRAND _____

PRE. MAX UPTAKE _____

APPENDIX B

1. From the results of the students' bike test, take the work-load that brought the students' heart rate closest to 150 beats per minute.

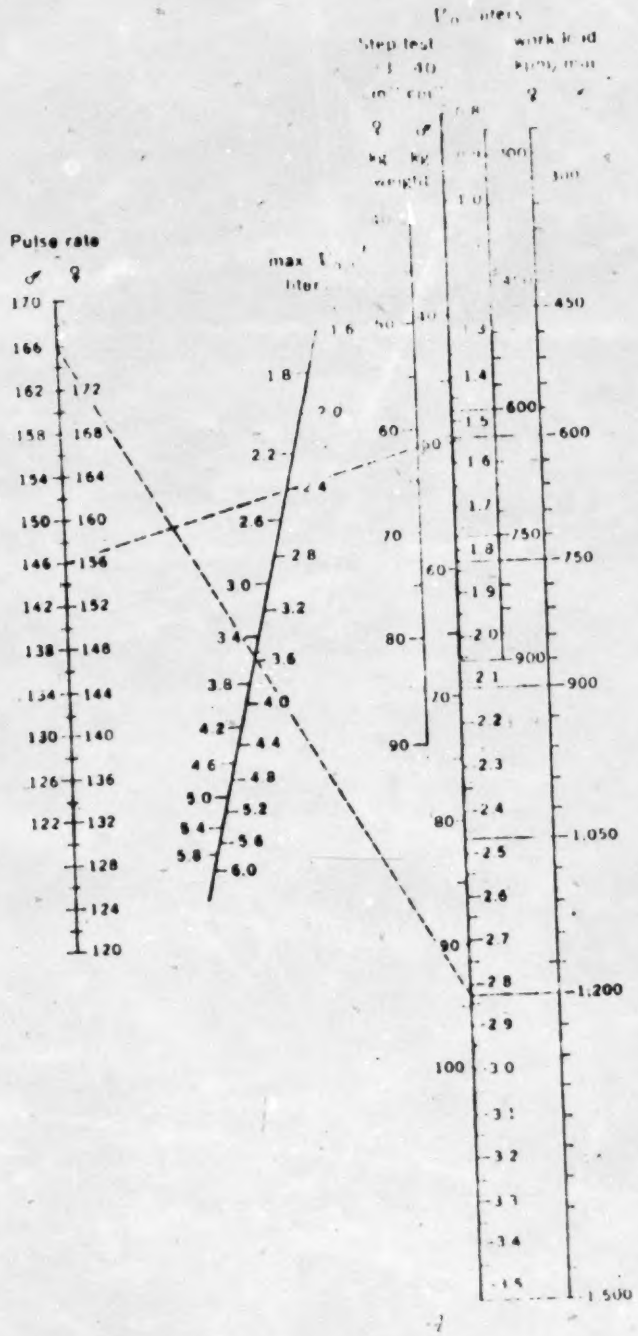
2. Read the work-load off the nomogram (600) and find the heart rate (146).

3. Join the 2 points.

4. The line you have just drawn intersects the maximal oxygen uptake line - Read the value (2.4 l/min.)

5. Divide this by the individual's body weight.

6. This gives you the individual's Astrand value.


Pulse rate
♂ ♀
max
liter
Step test
work load
kpm/min
♀ ♂
kg kp
weight
170
166
162
158
154
150
146
142
138
134
130
126
122
172
168
164
160
156
152
148
144
140
136
132
128
124
120
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
6.0
60
70
80
90
100
1.0
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3.0
3.1
3.2
3.3
3.4
3.5
450
600
750
900
1.050
1.200
1.500